FINAL TECHNICAL REPORT TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION COVERING THE PERIOD 4/15/91 TO 8/14/93 FOR NASA GRANT NAG5-1507 ENTITLED MODELING OF DYNAMICS EXPLORER UV IMAGES

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Publications and Papers Presented

Gladstone, G. R., "Simulations of DE-1 Airglow Images," *J. Geophys. Res.*, accepted for publication, 1994.

Chakrabarti, S., D. M. Cotton, and G. R. Gladstone, "An Analysis of Tropical Ultraviolet Nightglow," Fall Annual Meeting, American Geophysical Union, San Francisco, 1993.

Gladstone, G. R., "Resonance Line Radiative Transfer in the Aurora and Dayglow," (invited), 19th Annual European Meeting on Atmospheric Studies by Optical Methods, Kiruna, Sweden, 1992.

Gladstone, G. R., "Simulations of DE-1 Airglow Images," Fall Annual Meeting, American Geophysical Union, San Francisco, 1992.

Synopsis of Research

The objective of this work was to simulate the UV dayglow in images obtained by the Global Auroral Imager experiment on the Dynamics Explorer 1 satellite. In particular, we modified existing computer codes to allow modeling of O I 1304 Å and 1356 Å dayglow and nightglow emissions over the observed disk as seen from Earth orbit. This allows us 1) to better understand the basic nature of these emissions in the dayglow, 2) to study large scale variations in the structure of the dayglow (e.g., under geomagnetically disturbed conditions), and 3) to better study the dayside aurora by allowing accurate removal of contaminating dayglow emissions.

We combined existing codes for simulating the upper atmosphere (MSIS-86); solar EUV (K. Tobiska's code), photoelectron production, transport, and excitation of O I 1304 Å and 1356 Å emissions (R. Link's code); and resonance scattering of these emissions (R. Gladstone's code). The combined code calculates the expected brightness at the DE-1 spacecraft of several emissions that are excited by photoelectron impact, solar resonance scattering, and/or electron recombination, from up to several hundred points over the disk of the Earth. The code facilitates the detailed analysis of the relative contributions of the various sources of the principal emissions in the dayglow and nightglow. The model for simulating dayglow emissions includes the O I 1304 Å triplet, the O I 1356 Å doublet,

and the N_2 LBH bands, but neglects minor contributions from H I 1216 Å and N I 1493 Å emissions. The model for simulating nightglow emissions includes O I 1304 Å and 1356 Å features produced through radiative recombination of O^+ ions, but currently neglects an important source due to neutralization of O^+ and O^- ions.

Comparison of the DE-1 and model dayglow images indicate that the FUV dayglow emissions are well understood and can be simulated with fairly high accuracy. The relative contributions of the dayglow emission sources over the disk of the Earth are as follows: the O I 1304 Å emission is fairly uniform at about 15–20 kR over the disk; the optically thin LBH emissions become much larger than the O I 1304 Å emission at the limb, with a maximum band-integrated brightness of about 35 kR. Possible applications of the code include, for instance, studies of global variations in the composition and temperature structure of the upper atmosphere during and following geomagnetically disturbed conditions. Another possible use for the code is to accurately remove contaminating dayglow emissions from images of the dayside aurora.

We were not able to fit the DE-1 nightglow image chosen for simulation as well as the dayglow image, due to both the neglect of the mutual neutralization component and to the high spatial structure (compared to the dayglow) of the tropical arcs. The DE-1 nightglow image shows tropical arc count rates of several counts per pixel, implying recombination glows from O I 1304 Å and 1356 Å of several hundred Rayleighs each. An improved version of the DE-1 imager designed for nightglow observations could provide a tremendous set of global ionospheric data.